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IS 13911 (1993): Code of safety for sulphur [CHD 8: Occupational Safety, Health and Chemical Hazards]

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Indian Standard

SULPHUR – CODE OF SAFETY

UDC 661 25

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December **1993** **Price Group 3**

Chemical Hazards Sectional Committee, CHD 007

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council

The largest single use of sulphur is for the production of sulphuric acid. Sulphur is used in the flotation of ores to control *p*H in the production of magnesium from sea water, in the smelting of lead and other ores in the production of free-machining steels, in the treatment of boiler and cooling waters, to stabilize styrene monomer, for the impregnation of paper board and wall board.

Sulphur may appear in its characteristic yellow colour in a number of different allotropic modifications It occurs as lumps or as powder It is insoluble in water but as is soluble to varying degrees in many organic solvents such as carbon disulphide, benzene, warm aniline, warm carbon tetrachloride and in liquid ammonia

In the preparation of this code of safety, considerable assistance has been derived from the following publications

i) Encyclopedia of chemical technology by Raymond E KIRK and Donald F OTHEMER

ii) Dangerous properties of industrial materials — N Irving Sax Sixth Edition

iii) Data sheet No 1-6/2-Rev 84, 'Handling and Storage of Solid Sulphur', National Safety Council, Chicago, U S A 1984

iv) Booklet on TLV's ACGIH, 1984 85

The composition of the technical committee responsible for the formulation of this standard is given in Annex A

AMENDMENT NO. 1 MAY 2002
TO
IS 13911 : 1993 SULPHUR - CODE OF SAFETY

[*Page* 1 *clause* **4.2.6(**b)] — Substitute '115 2°C' *for* '119°C'

(*Page* 1, *clause* **4.4.3**) — Insert the following new clause after **4 4.3** and renumber the subsequent clauses

4.4.4 Sulphur produced from refineries contain hydrogen sulphide up to 15 ppm When this sulphur is melted in closed melting pits, hydrogen sulphide in the sulphur gets liberated and can be built up at the top of molten sulphur exceeding its explosive limit of 3 5 percent.'

(*Page* 2 *clause* **7.2.5**) — Insert the following new clause after **7.2.5**

'7.2 6 When sulphur is melted in pits, sufficient care has to be taken to dispel any hydrogen sulphide accumulated over the surface of the molten sulphur'

(CHD 7)

Reprography Unit, BIS, New Delhi India

Indian Standard

SULPHUR - CODE OF SAFETY

1 SCOPE

1.1 This code describes properties of sulphur, the nature of hazards associated with it and essential information on storage, handling, transportation, labelling, waste disposal, training of personnel, personal protective equipment and first aid

1 2 This code does not deal with any specification for the design of building chemical engineering plant and equipment for waste disposal, but general precautionary measures in these respects should be taken

2 REFERENCE

IS 4155 1966 'Glossary of terms relating to chemical and radiation hazards and hazardous chemicals' is necessary adjunct to this standard

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 4155 1966 shall apply

4 GENERAL PROPERTIES

4.1 General Information

Elemental sulphur in its ore or refined state is generally recognized by its characteristic yellow colour or by its generation of sulphur dioxide when burnt in air

4.2 Physical Properties

4.2.1 *State* — Solid

4.2.2 *Colour* — Yellow

4 2 3 *Odour* — Odourless

4.2 4 *Hygroscopicity* — Non hygroscopic

4.2 5 *Density*

a) Rhombic — 2 07 g/cm^3 at 20°C
b) Monoclinic – 1 96 g/cm^3 at 20°C

4 2 6 *Melting Point*

a) Rhombic – 113°C
b) Monoclimc — 119°C

4.2.7 *Boiling Point* – 444 6°C

4.2.8 *Vapour Pressure* — 1 mm Hg at 183 8°C

4.3 Chemical Properties

In the presence of oxygen or dry air, sulphur is very slowly oxidized to form sulphur dioxide When burnt in air, it forms predominantly sulphur dioxide with small amounts of sulphur trioxide In the presence of moist air, sulphurous and sulphuric acids are slowly generated

4.4 Fire and Explosion Hazard Properties

Sulphur is flammable Dust or vapour of sulphur forms explosive mixture with air It is hazardous in contact with oxidizing materials, forming explosive mixtures

4.4.1 *Flash Point* (*Close Cup*) - 207 2 °C

4 4.2 *Auto ignition Temperature* — 232 2 °C

4 4.2.1 Auto-ignition temperature of sulphur dust in air are

Dust clouds — 190 0 °C
Undispersed dust — 221 1 °C

4.4 3 *Explosive Limit*

The explosive limits of sulphur dust in air are 35 04 g/m^3 minimum and 1 401 g/m^3 maximum

4 4.4 A serious hazard of solid sulphur is fire and dust explosion, as mixtures of sulphur dust and air ignite easily The ignition temperature is fairly low and the explosive limit range is relatively wide A small explosion may cause additional dust disturbance which, if ignited, may result in a more severe explosion and ignition of the pile itself Dusts with 25 percent sulphur content or more may be as explosive as pure sulphur

4.4.5 Solid sulphur may be ignited by frictional heat, sparking from steel tools or handling equipment and contact with oxidizing chemicals

4 4 6 *Static Electricity*

Solid sulphur is a poor conductor of electricity and tends to develop charges of static electricity during transport or processing Static discharges may lead to the ignition of sulphur dust

4 5 Corrosivity

Sulphur itself is regarded as a non corrosive substance in regard to the usual materials of construction. Dry, molten sulphur is handled satisfactorily in mild steel or cast iron equipments However, acid generating impurities which may be introduced during handling and storage, create corrosive conditions The exposure of sulphur to moisture and air causes the formation of acids which attack a number of metals To combat such corrosion incidents, protective coatings of organic compounds, cements or sprayed resistant metals are often applied to exposed steel surfaces, including pipe and equipment handling liquid sulphur and to structural members in contact with solid sulphur Also practical, in some applications is use of resistant metal alloys, particularly of the aluminium and stainless steel groups Neutralization of the generated acids by the addition of basic chemicals is sometimes adopted

5 HEALTH EFFECTS AND TOXICITY INFORMATION

5.1 Systemic Effects

No mention is found in the literature of systemic poisoning due to inhalation of sulphur dust

5 2 Toxicity

Sulphur is virtually non-toxic However finely powdered sulphur when taken orally, may be toxic The toxicity hazard rating (TLV) is 10 49 mg/m^3 (8 ppm)

5 3 Symptom on Exposure

5 3.1 Sulphur is capable of irritating the ocular conjunctive and the mucus membranes of the respiratory passages

5.3.2 Powdered sulphur may occasionally produce an irritant action on the skin and in certain cases may take an eczematous form in pre disposed individuals

5 3.3 Burning sulphur produces toxic sulphur dioxide gas

6 PERSONAL PROTECTIVE EQUIPMENTS

Avoid contact with solid or liquid sulphur Use safety goggles or face shield, rubber hand gloves and rubber boot and dust mask The protective equipment used shall be of the quality prescribed in the relevant Indian Standards wherever available

7 STORAGE, HANDLING AND TRANSPORT

7.1 Storage

7.1.1 Sulphur is normally stored in PCC bins It shall be ensured that it is stored away from ignition sources or oxidizing agents

7 1 2 Storage bins for buildings should be provided with water fog arrangements

7.1 3 To prevent dust formation, enclosures should be constructed with minimum number of ledges where dust can accumulate Necessary ledges should be roofed at a steep angle to reduce dust deposits

7.1.4 While working in bins of sulphur or bulk piles, precaution should therefore be taken to avoid overhangs and slides Undercutting of piles, especially manually, must be avoided The angle of repose for loose bulk sulphur is 35° and pulled sulphur is 25°

7.2 Handling

7.2 1 Rubber gloves and protective clothing and safety goggles should be worn while handling the material

7.2.2 Precaution should be taken to prevent dust formation and avoid potential source of ignition

7.2.3 To prevent ignition by friction, hand tools used in handling solid sulphur should be made from non sparking material such as monel, non-ferrous alloys, aluminium or wood

7 2.4 Conveyer should be constructed of non-ferrous material, or if ferrous material is used for one part, parts that might touch it should be non ferrous to minimize the chance of sparking

7 2.5 'Long' drop through chutes should be kept at a minimum to avoid dust formation

7.3 Transport

Sulphur is transported under cool and ventilated conditions It may be transported in open wagons or open trucks either loose or filled in gunny bags

8 SPILLS AND LEAKAGES

Spilled/leaked sulphur may be recovered and recycled However in the case of minor spills/ wastes the material may be collected and deposited in authorised/approved land fills

9 FIRE PREVENTION AND FIRE FIGHTING

9 1 To avoid fire, all ignition sources shall be removed from the area of use of sulphur All electrical fittings shall be dust and explosion free

9.2 Solid Sulphur

A fine water spray fog or foam is the best extinguishing agent Hoses and extinguishers with pressure streams should not be used where solid sulphur is dusty or where it may create a further hazard by raising more dust clouds Small sulphur fires may be extinguished by carefully smothering with larger amount of the same sulphur itself or sand dirt etc

9.3 Liquid Sulphur

In the case of fire in liquid sulphur, it is preferable to cut air supply and smother the fire with steam Solid stream of water to smother fire should be avoided as it can result into steam explosion

9.4 Breathing Apparatus

Burning sulphur evolves sulphur dioxide and therefore fire fighters of such fires should use self contained breathing apparatus In case such protections are not readily available, fumes from such fires should be avoided, if possible, by approaching from the upwind side

10 TRAINING AND HEALTH MONITORING

10 1 Training and Education

Safety in handling sulphur depends upon the degree of awareness of the employees about the hazardous nature of sulphur Proper safety instructions and intelligent supervision, correct use of safe equipment, use of personal protective equipments and a thorough working knowledge are to be ensured Material Safety Data Sheets (MSDS) shall be available at sites handling

10 2 Health Monitoring

Regular medical examination for the personnel engaged in handing sulphur is advisable The use of vegetable oil/petroleum jelly externally by the workers handling sulphur is suggested to avoid skin irritation

11 FIRST AID

11 1 Skin Contact

The area of contact is washed with soap and water A small quantity of vegetable oil/petroleum jelly may be applied over the area of contact after washing and drying

11 2 Eye Contact

The eye and the eyelids are washed with plenty of water If irritation persists, medical attention shall be sought immediately

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Chemical Hazards Sectional Committee, CHD 007

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SHRI T RANGASAMY
Joint Director (Chem), BIS

(*Continued on page 5*)

(*Continued from page* 4)

Miscellaneous Hazards Subcommittee, CHD 007 05

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DOC No CHD 07(9198)

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Printed at New India Printing Press Khurja India